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# Design and Development of Cooling Tower Using Pizza Type of Fills

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**Abstract:** *This project focuses on the design and development of a cooling tower utilizing pizza-type fills, a novel approach to enhance the cooling efficiency of the system. Cooling towers play a vital role in industrial and HVAC applications by dissipating heat from water-cooled systems to the atmosphere. Traditional cooling towers often face challenges such as uneven water distribution and inefficient heat exchange. The implementation of pizza-type fills named for their radial, segmented design resembling pizza slices aims to improve air-water interaction, maximize surface area, and promote uniform water distribution, ultimately leading to more efficient cooling. This report outlines the research, design methodology, material selection, and performance evaluation of the cooling tower equipped with these fills. Through theoretical analysis and experimental testing, the project demonstrates the potential of pizza type of fills to reduce operational costs, optimize energy usage, and improve the overall performance of cooling towers in various industrial environments. The findings indicate that this innovative design could be a sustainable and cost-effective solution for future cooling technologies.*

**Keywords:** pizza type fills, uniform water distribution

## I. INTRODUCTION

Cooling towers are essential components in industrial and HVAC (Heating, Ventilation, and Air Conditioning) systems, responsible for dissipating excess heat from water-cooled processes into the atmosphere. However, conventional cooling tower designs often encounter limitations such as poor heat exchange efficiency and uneven water distribution. In response to these challenges, this project introduces an innovative cooling tower design that incorporates pizza-type fills—a radial, segmented fill structure inspired by the shape of pizza slices. This design aims to enhance the air-water contact surface area and promote uniform water flow, thereby improving the overall thermal performance of the cooling tower. The primary goal of this study is to investigate the effectiveness of pizza-type fills in optimizing energy use, reducing operational costs, and increasing cooling efficiency through both theoretical analysis and experimental testing.

## II. PROBLEM STATEMENT

Cooling towers play a vital role in industrial and power generation processes, providing essential heat rejection to prevent equipment overheating and maintain operational efficiency. However, common issues such as fouling, scaling, and clogging of fills result in reduced cooling efficiency and increased maintenance demands. Current cooling tower designs primarily focus on improving efficiency and minimizing evaporation losses but often overlook the importance of easy maintenance access. Difficulties in cleaning and replacing fills lead to gradual performance degradation, impacting long-term operational effectiveness.

This project aims to design and develop a cooling tower that addresses these critical issues by simplifying maintenance processes. The objective is to create a system that ensures consistent performance over time by enabling easier access for cleaning and component replacement. By focusing on maintenance accessibility alongside efficiency, this project seeks to bridge the existing gap in cooling tower design, providing a sustainable solution for prolonged and reliable cooling performance in industrial applications.


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## III. OBJECTIVE & ANALYSIS

- Design and develop a cooling tower that simplifies maintenance processes.
- Address the critical gap in existing cooling tower systems regarding maintenance and efficiency.
- Ensure consistent operational performance over time
- Focus on easy access for cleaning and replacing components.

## IV. DESIGN & CALCULATIONS

**Design of Cooling Tower:**

We are using the Welltech WB-CZ101-C1 as an ideal cooling tower. Based on its specifications, we are designing a modified tower to improve performance and efficiency for comparison.

**Welltech Cooling Tower (WB-CZ101-C1) Specifications:**

Model: WB-CZ101-C1
Diameter: 930 mm
Height: 1570 mm
Inlet Pipe Diameter: 40 mm Outlet Pipe Diameter: 40 mm Motor Capacity: 0.5 hp
Motor RPM:1440
Fan Diameter: 450 mm
Water Flow Rate: 120 liters/min
Cooling Tower Capacity: 12 TR (Tons of Refrigeration)

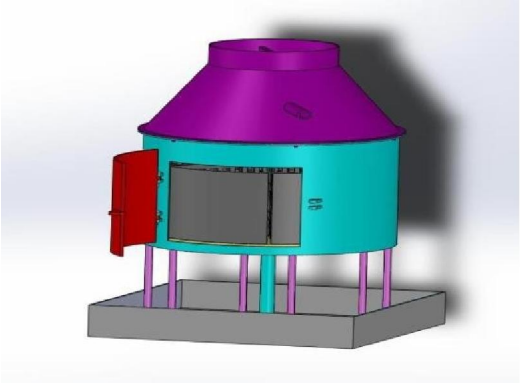

**Fig -1**: Cad model

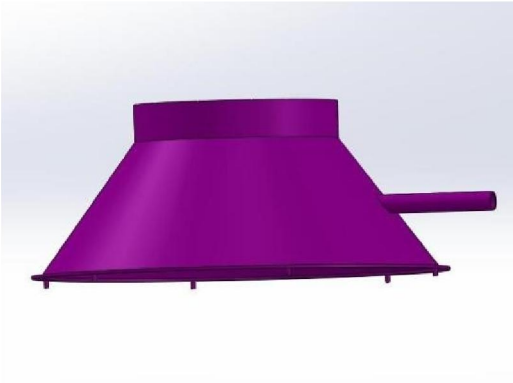

**Fig -**: 2 Upper dome

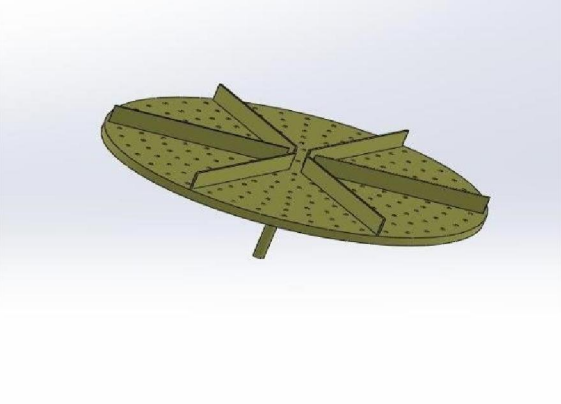

**Fig -3**: Base plate

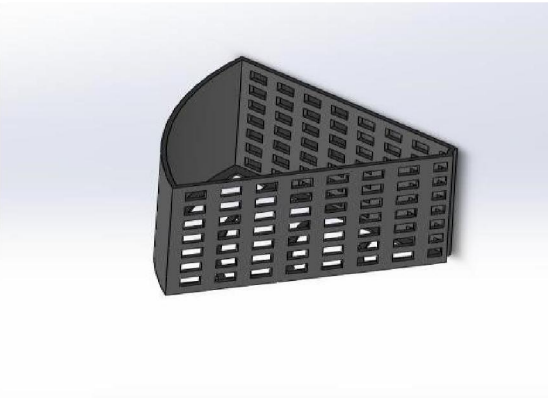

**Fig -4**: Fill Drawer

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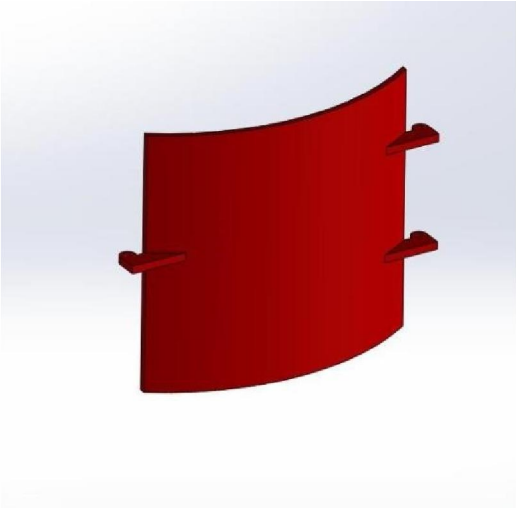

**Fig -5**: Door

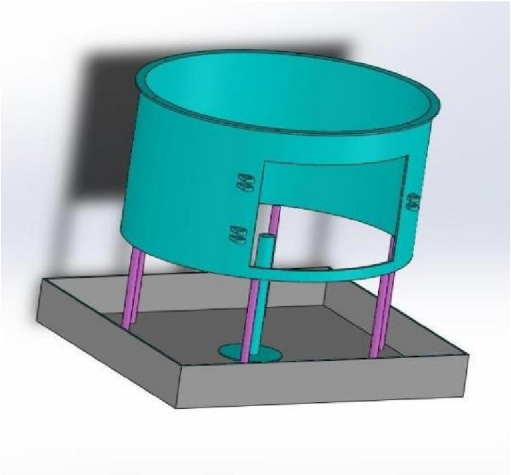

**Fig -6**: Lower body

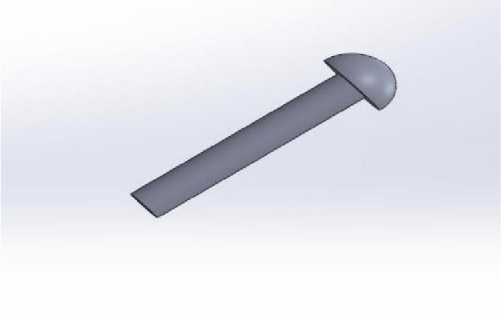

**Fig -7**: Pin

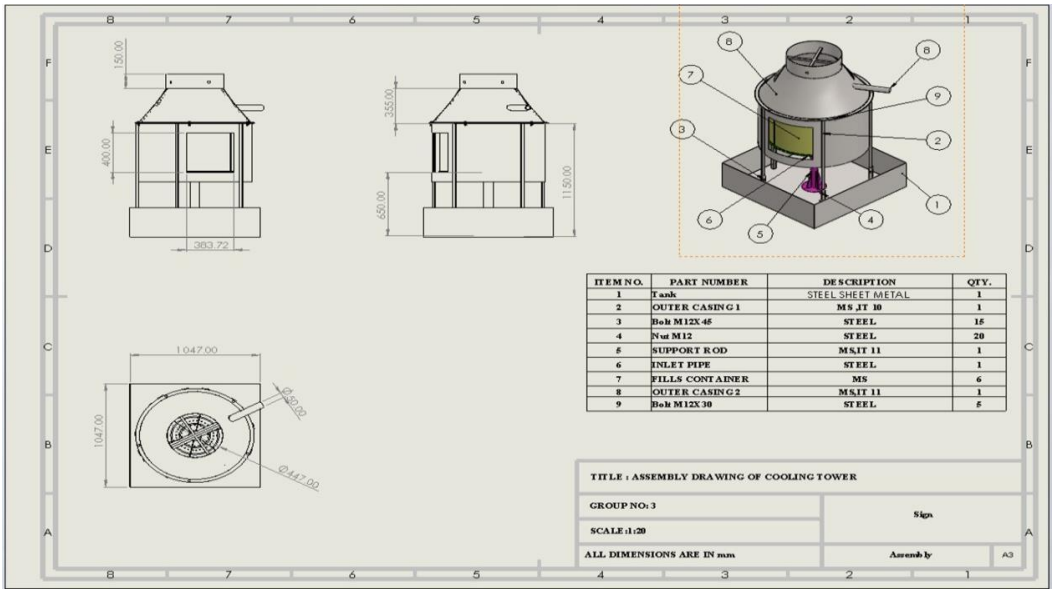


**Fig -8**: Production Drawing of cooling tower


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## V. PERFORMANCE ANALYSIS

Parameters required to calculate performance of cooling tower: Inlet temp of air ($t_1$)
Outlet temp of air ($t_2$) Inlet temp of water ($T_1$) Outlet temp of water ($T_2$) Wet bulb temp
Mass Flow Rate (v)
Enthalpy of water at inlet temp ($Hw_1$) Enthalpy of water at outlet temp (Hw2) Enthalpy of air at inlet temp ($Ha_1$) Enthalpy of air at outlet temp ($Ha_2$)

**Calculation for performance of cooling tower:**

**Range:**

= Hot water temp ($T_1$) – Cold water ($T_2$)

**Approach:**

= Cold water temp ($T_2$) – Wet bulb temp

**Mass of water:**

Mw = Mass flow rate * density of water

**Mass flow rate:**

=Area*Velocity

Heat loss by water**:**

$HL = Mw \times CPw \times (T1 - T2)$

**Calculation for performance of cooling tower:**

Heat gained by air (Hg):

= Enthalpy of hot air (Ha1) – Enthalpy of cold air (Ha2)

Efficiency of cooling tower =Range / [Range + Approach] η = [(T1-T2)/ (T1 - WBT)]

Capacity of cooling tower

$= Mw \times CPw \times (T1 - T2)$

## VI. CONCLUSION

The development and testing of a cooling tower equipped with pizza-type fills have demonstrated promising results in terms of performance enhancement and energy efficiency. The radial, segmented design of these fills has been shown to significantly improve water distribution and heat exchange within the system. Experimental evaluations confirm that the proposed design not only enhances cooling efficiency but also contributes to cost- effective and sustainable operation in industrial applications. These findings suggest that pizza-type fills represent a viable and innovative advancement in cooling tower technology, with the potential to be adopted widely in future HVAC and industrial cooling systems.

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